

FIG 1

LISP S-expression

102

$(+ (* 5 (sqrt 4)) (/ 6 3)))$

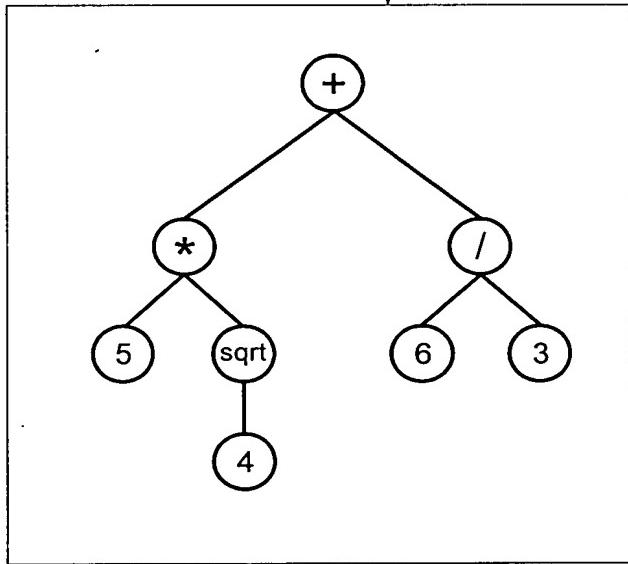
Conventional mathematical expression

101

$$5 \cdot \sqrt{4} + \frac{6}{3}$$

Tree representation

103



Coding region of a chromosome of the present invention

104

+ * / 5 Q 6 3 4

105

0908669200 - 2002000000

FIG 2

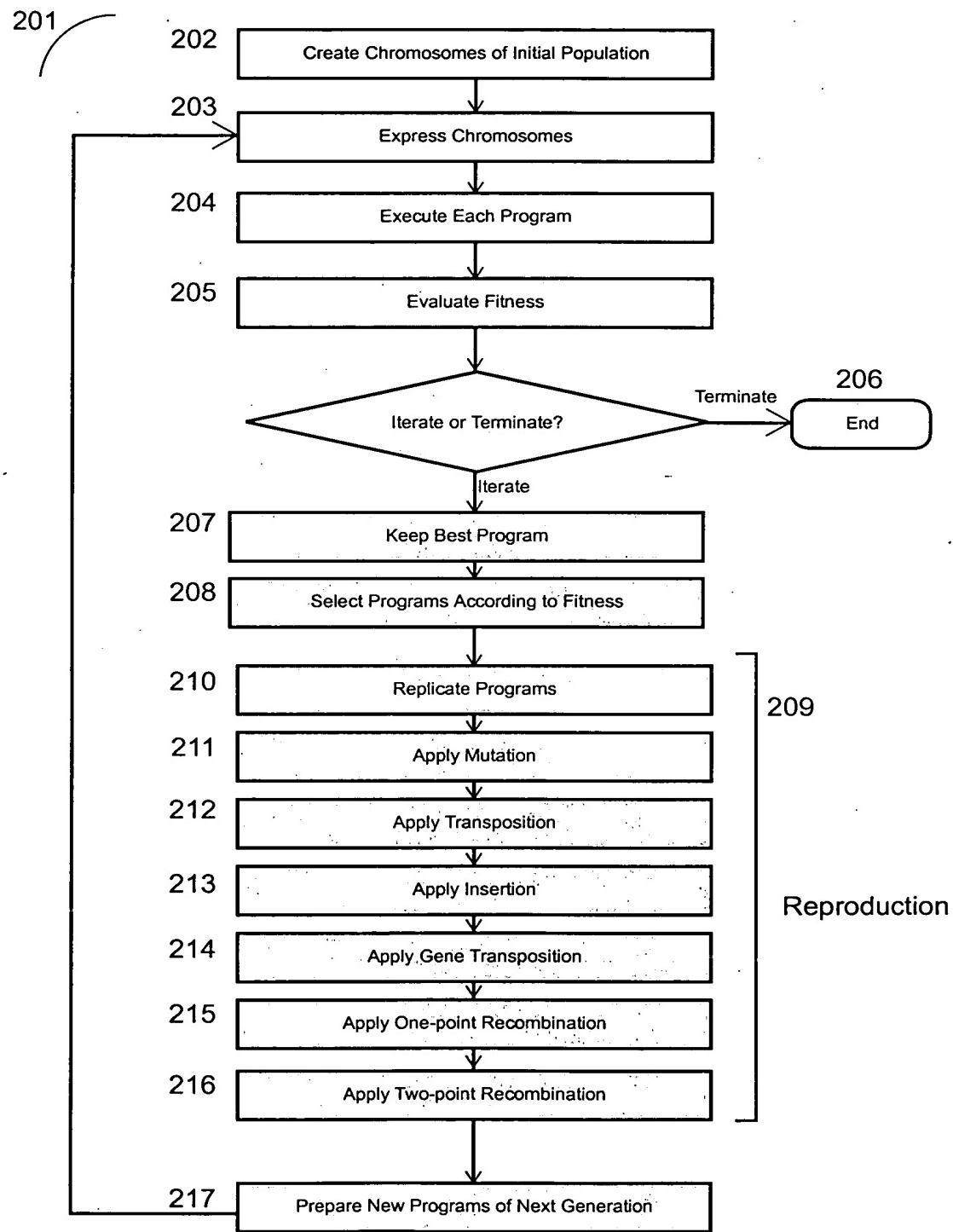


FIG 3

305 306 307 308 309 310
h1 t1 h2 t2 h3 t3
301 Q+aabbaab_* --- babba_* / b - bbaaa
 gene 1 gene 2 gene 3
 302 303 304

FIG 4

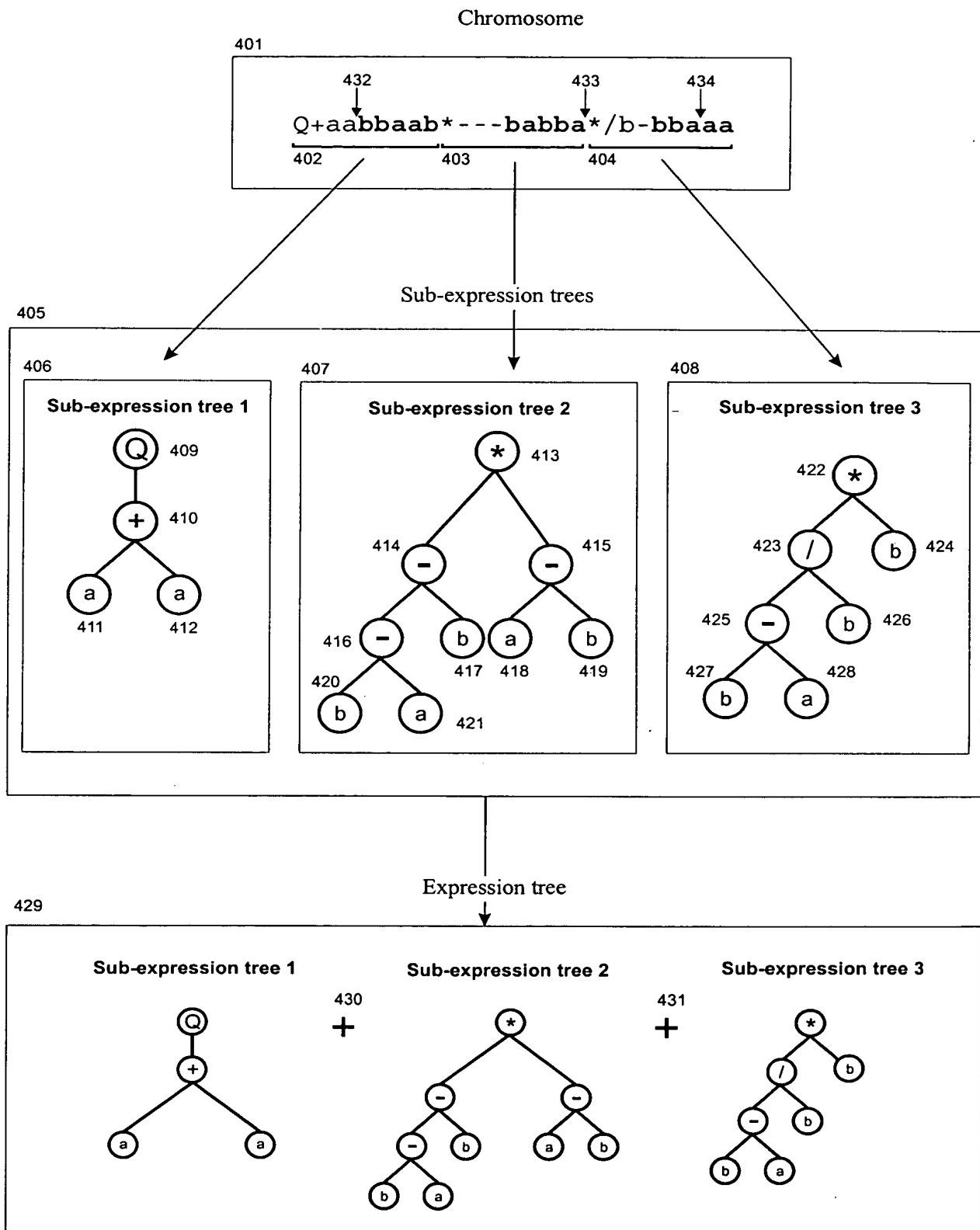
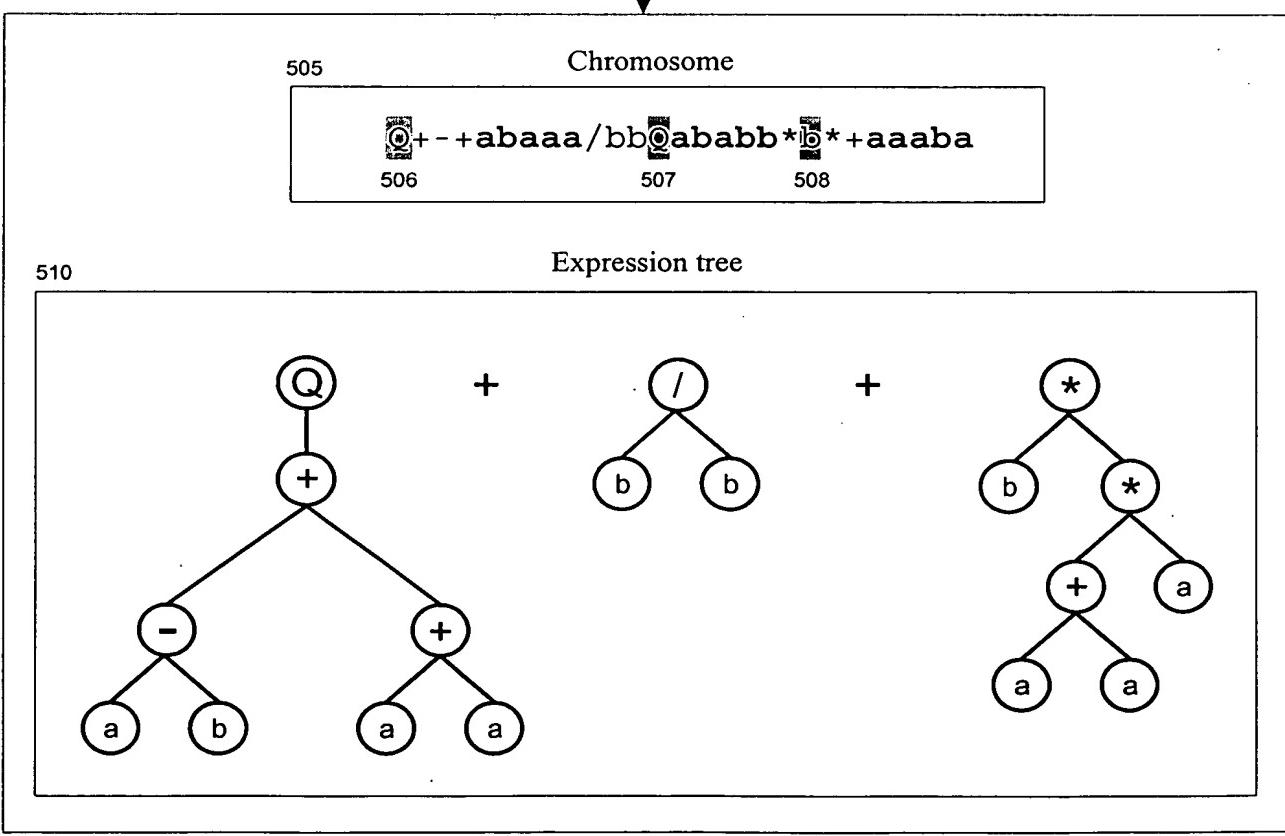
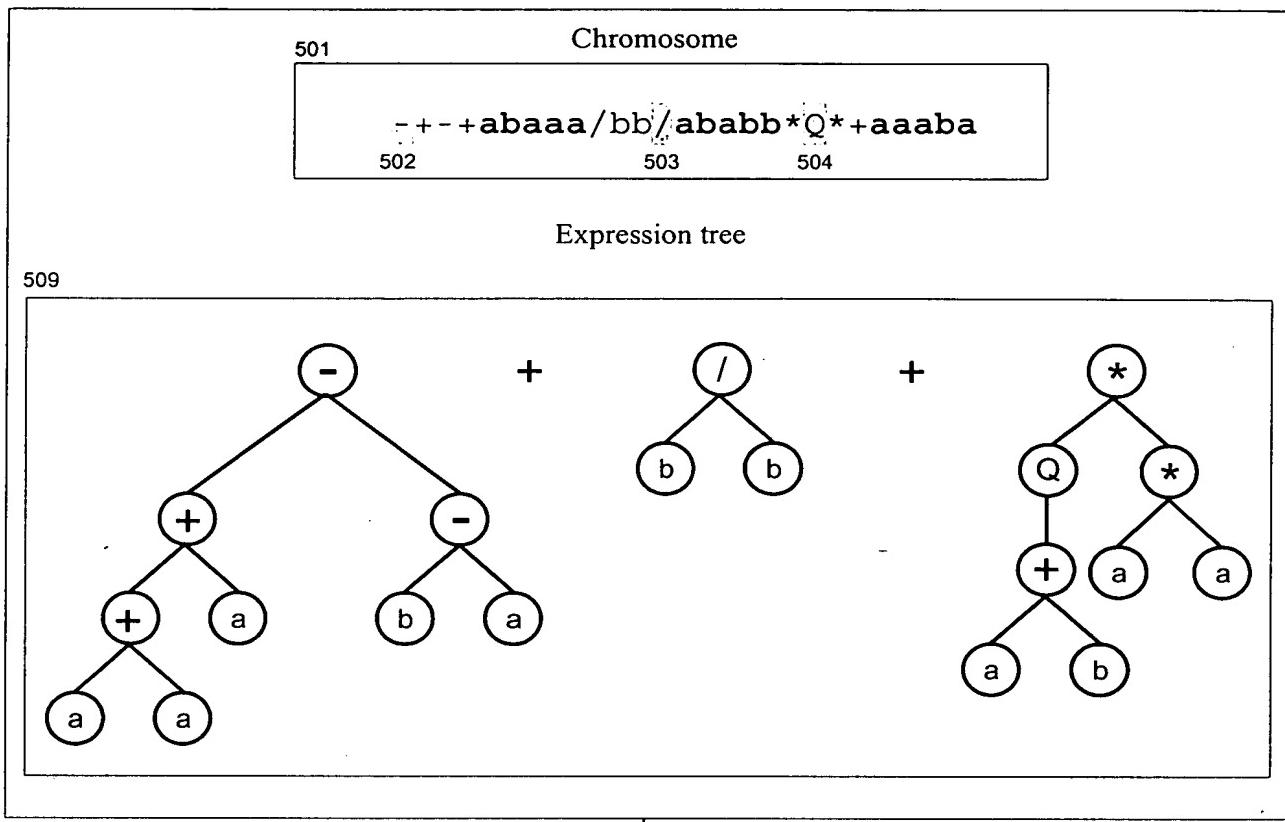


FIG 5



0000000000 = 2682040000

FIG 6

601

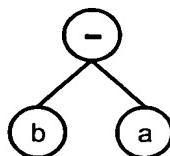
Chromosome

602
 $-ba * + - + -Q / abababbbaaaQ * b / +bbbabbaaaaaaaaabbb$

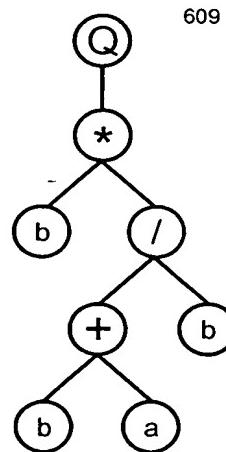
gene 1 605

gene 2 606

Expression tree



+



603

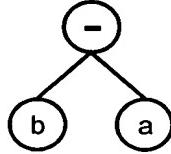
Chromosome

604
 $-ba * + - + -Q / abababbbaaa +bbQ * b / +bbbabbaaaaaaaaabbb$

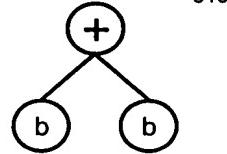
gene 1' 607

gene 2' 608

Expression tree



+



610

FIG 7

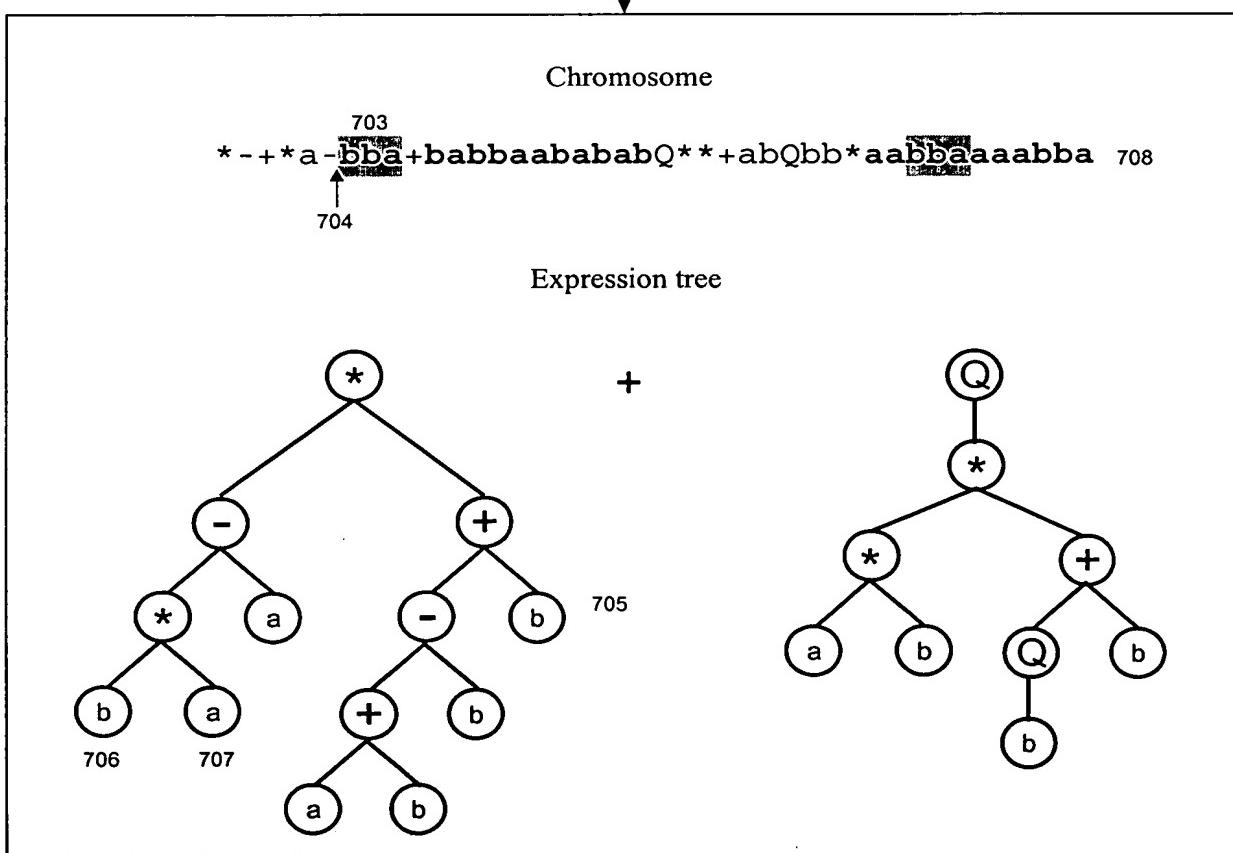
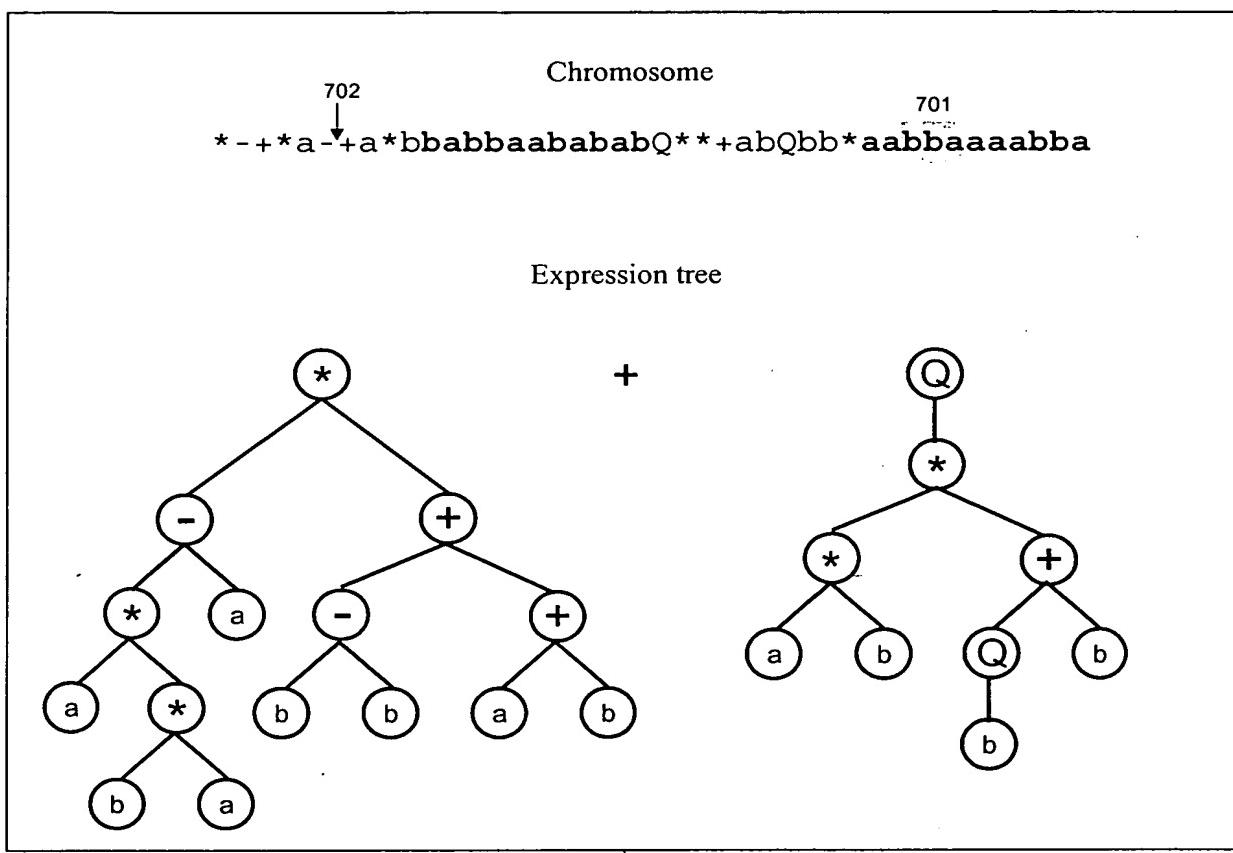
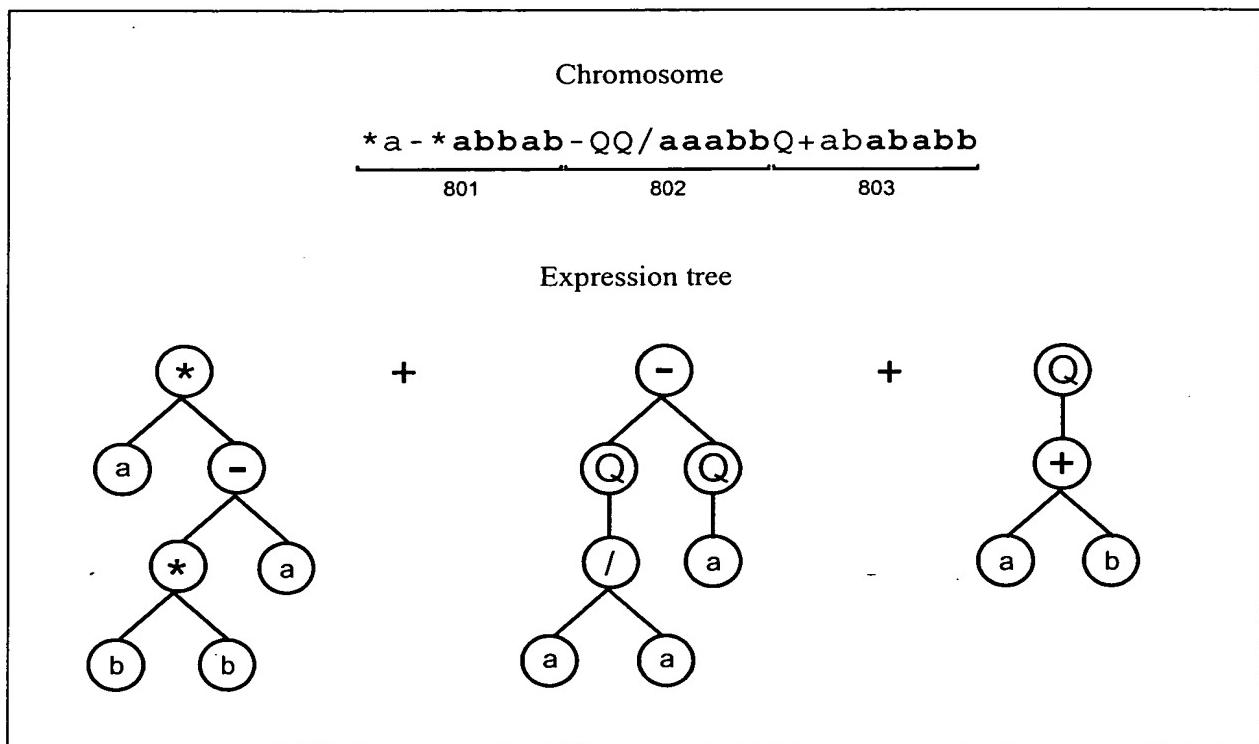


FIG 8



ପ୍ରକାଶକ ମନ୍ତ୍ରୀ

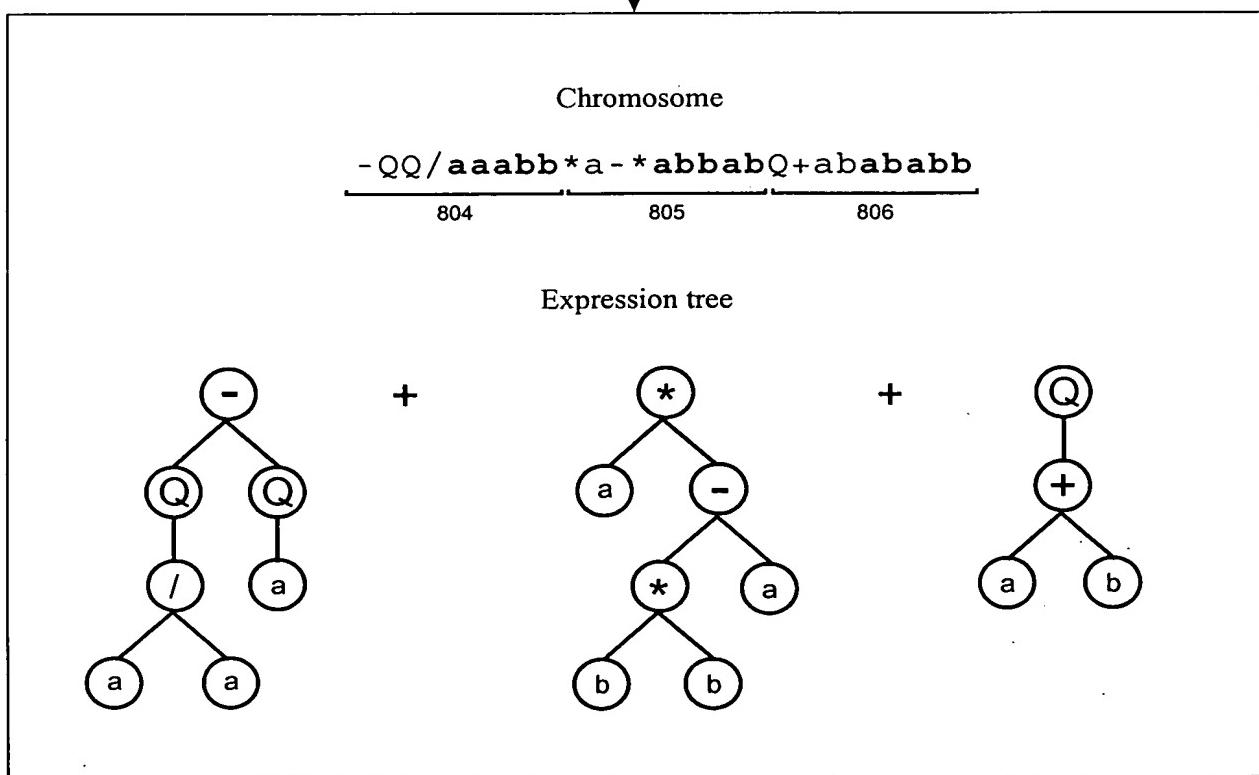


FIG 9

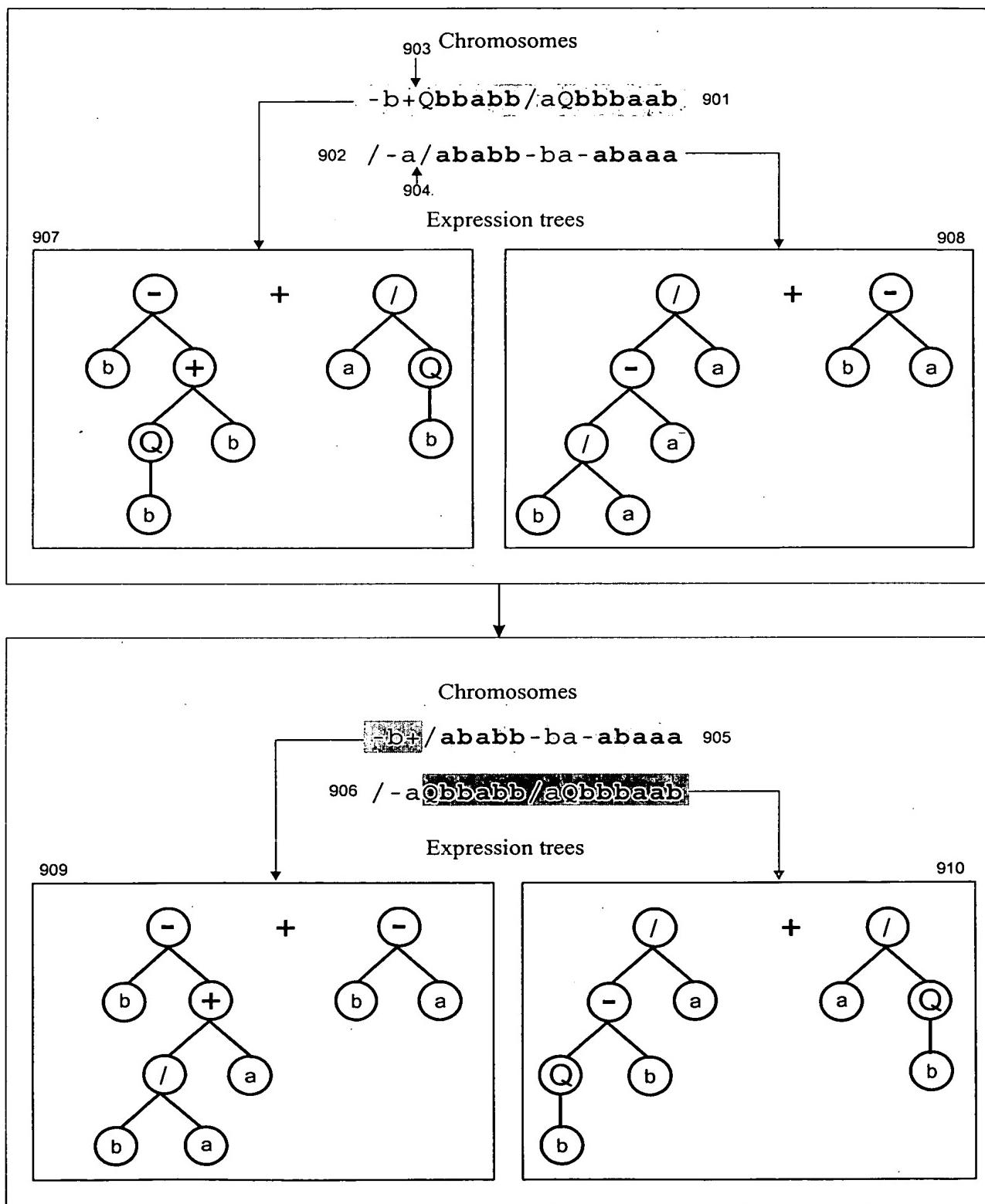


FIG 10A

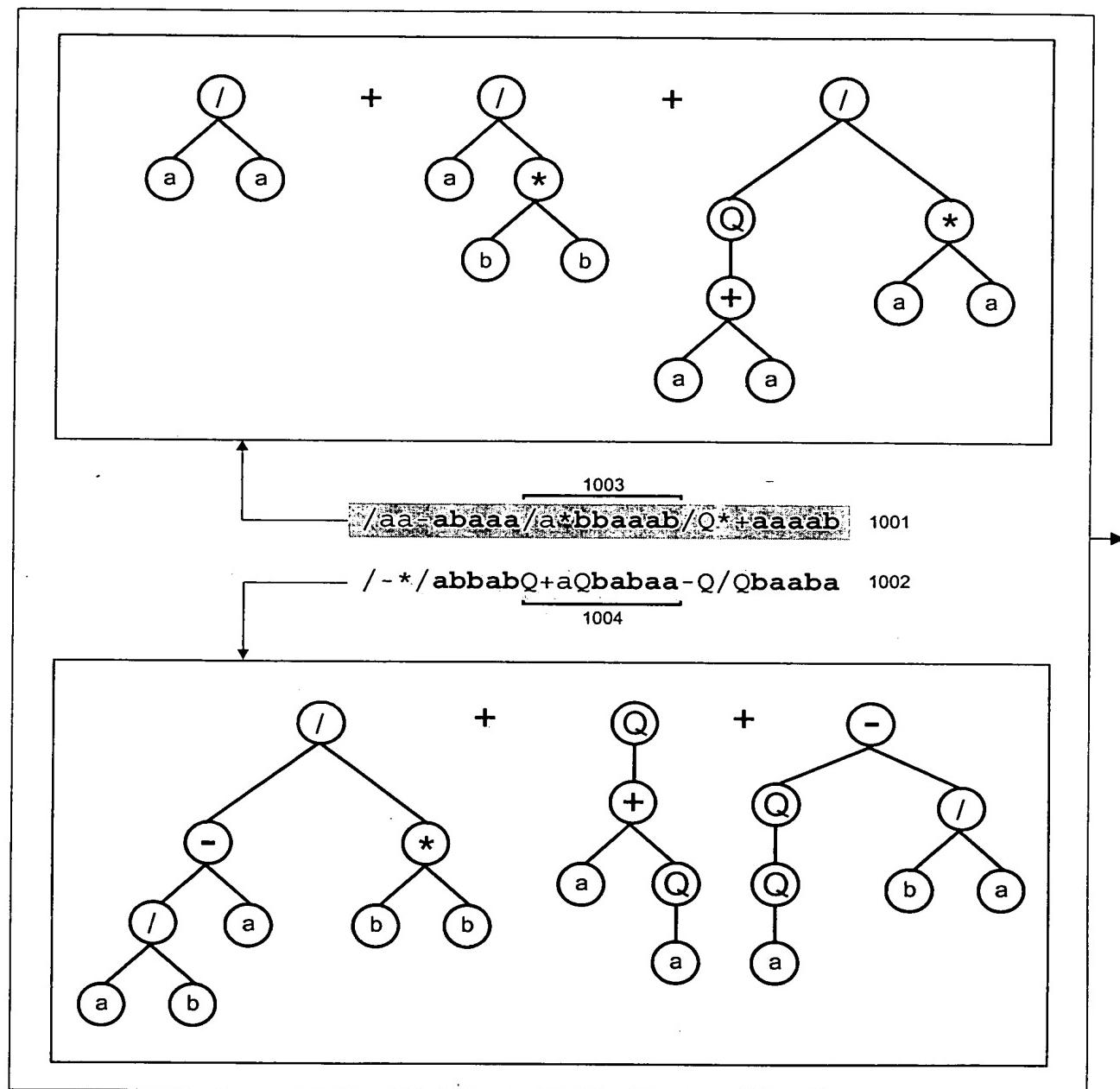


FIG 10B

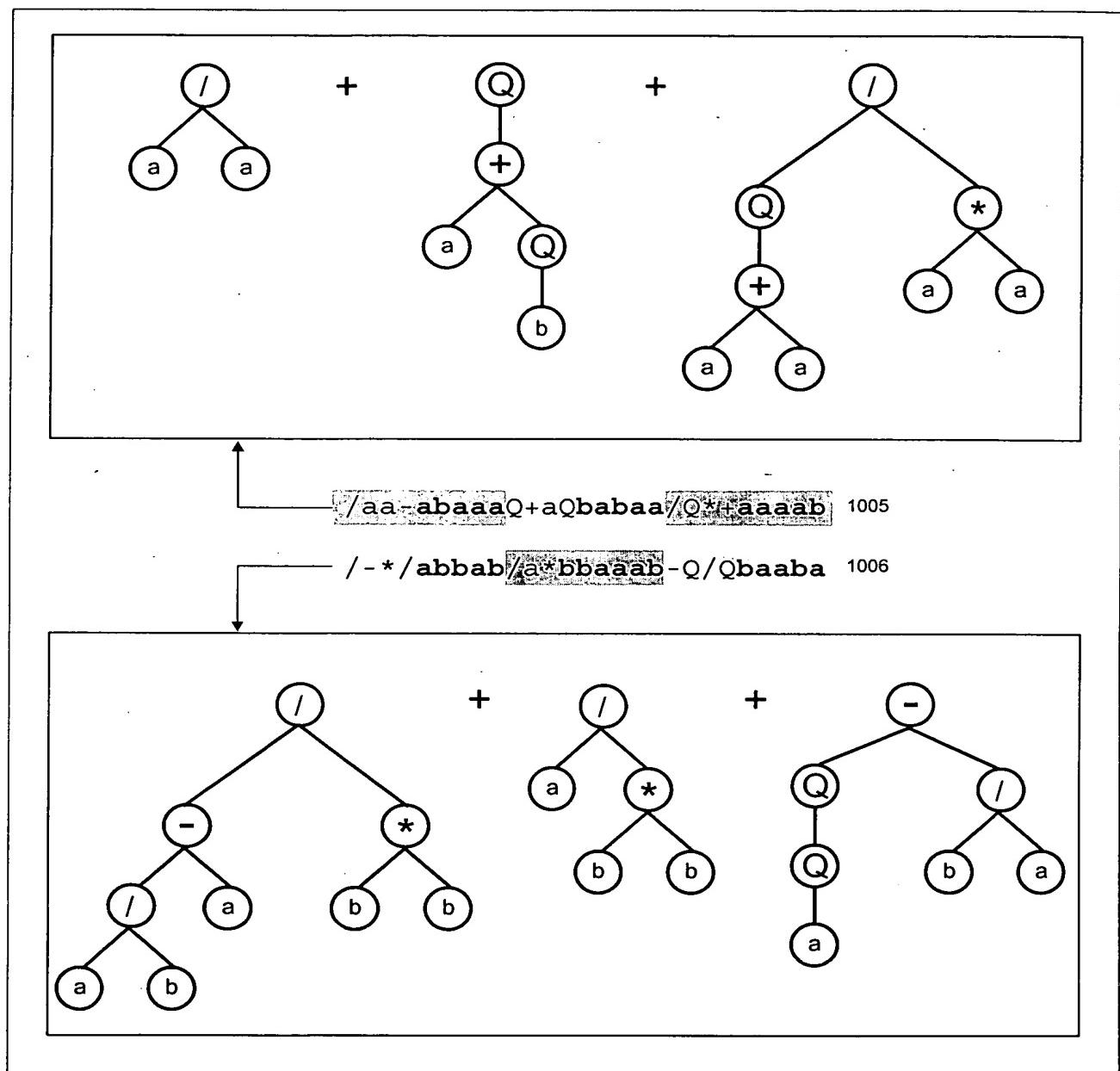


FIG 11

1101	Chromosomes	Fitness
	//*/-aaaaaaaa----+aaaaaaa*+**+aaaaaaa*+++-aaaaaaaa-[0]	= 0
	//+//aaaaaaaa+/*+/aaaaaaaa*-a-*aaaaaaaa-a***+aaaaaaaa-[1]	= 0
	+a**+aaaaaaaa+-++-aaaaaaaa*---aaaaaaaa*+**-aaaaaaaa-[2]	= 73.35578
	+**a*-aaaaaaaa/+-a/aaaaaaaa-/+**aaaaaaaa**/-aaaaaaaa-[3]	= 0
	/+/**aaaaaaaa/a/++aaaaaaaa+/aa+aaaaaaaa*/-/aaaaaaaa-[4]	= 26.6697
	++/-aaaaaaaa/-*/aaaaaaaa*+**aaaaaaaa/a*a-aaaaaaaa-[5]	= 0
	+**//aaaaaaaa-*a*aaaaaaaa-/**/aaaaaaaa/++/*aaaaaaaa-[6]	= 25.44238
	---aaaaaaaa+a**aaaaaaaa-a***aaaaaaaa/-*-aaaaaaaa-[7]	= 0
	-*a+-aaaaaaaa**a**aaaaaaaa+*-a-aaaaaaaa//++++aaaaaaaa-[8]	= 22.67557
	/++-+aaaaaaaa*a/*+aaaaaaaa/aa*+aaaaaaaa-*a-aaaaaaaa-[9]	= 0
	+a/+aaaaaaaa++/-aaaaaaaa*+/*/aaaaaaaa-*a--aaaaaaaa-[10]	= 35.0658
	-+a-*aaaaaaaa*+**/aaaaaaaa-+/-aaaaaaaa*a/+/aaaaaaaa-[11]	= 97.6903
	/aa**aaaaaaaa*+///aaaaaaaa/*a**aaaaaaaa+***/aaaaaaaa-[12]	= 45.73774
	-a-aaaaaaaa+-/aaaaaaaa*--*-aaaaaaaa---a-aaaaaaaa-[13]	= 0
	++*/-aaaaaaaa-*a/aaaaaaaa*/-/+aaaaaaaa/++-+aaaaaaaa-[14]	= 0
	++*//aaaaaaaa*/**/aaaaaaaa/a-aaaaaaaa---+aaaaaaaa-[15]	= 0
	/aa--aaaaaaaa-+*/-/aaaaaaaa+**a/aaaaaaaa-/a++aaaaaaaa-[16]	= 7.7575
	++*-aaaaaaaa+*+-aaaaaaaa+a-+*aaaaaaaa/a-*aaaaaaaa-[17]	= 0
	++**+aaaaaaaa/-+*-aaaaaaaa-*a/+aaaaaaaa*+*-aaaaaaaa-[18]	= 0
	+a-+*aaaaaaaa/a+/aaaaaaaa//**-aaaaaaaa*/a*/aaaaaaaa-[19]	= 0
	--a+-aaaaaaaa*aaa/aaaaaaaa+*/-/aaaaaaaa*a/+/-aaaaaaaa-[20]	= 21.5497
	/++**aaaaaaaa+a+/aaaaaaaa*+---aaaaaaaa/+*a+aaaaaaaa-[21]	= 18.06512
	/+aa-aaaaaaaa+//*aaaaaaaa*a+/-aaaaaaaa-*/*-aaaaaaaa-[22]	= 17.4636
	/-/+aaaaaaaa/-+*+aaaaaaaa/a/-*aaaaaaaa+-*++aaaaaaaa-[23]	= 0
	++*-aaaaaaaa/*a-*aaaaaaaa/-+-aaaaaaaa+/-*/aaaaaaaa-[24]	= 27.9458
	-/-+aaaaaaaa-+a*aaaaaaaa+---+aaaaaaaa-+/aaaaaaaa-[25]	= 0
	++-aaaaaaaa/+/+aaaaaaaa-*a/*aaaaaaaa+*-a/aaaaaaaa-[26]	= 18.2736
	-*+a+aaaaaaaa/-/+aaaaaaaa**aa*aaaaaaaa/-/a-aaaaaaaa-[27]	= 80.0881
	/-++-aaaaaaaa*+/-aaaaaaaa/-+*aaaaaaaa/-*++aaaaaaaa-[28]	= 0
	+-*/aaaaaaaa-*---+aaaaaaaa//a/+aaaaaaaa*a+/aaaaaaaa-[29]	= 31.31912
	Chromosome number	

FIG 12

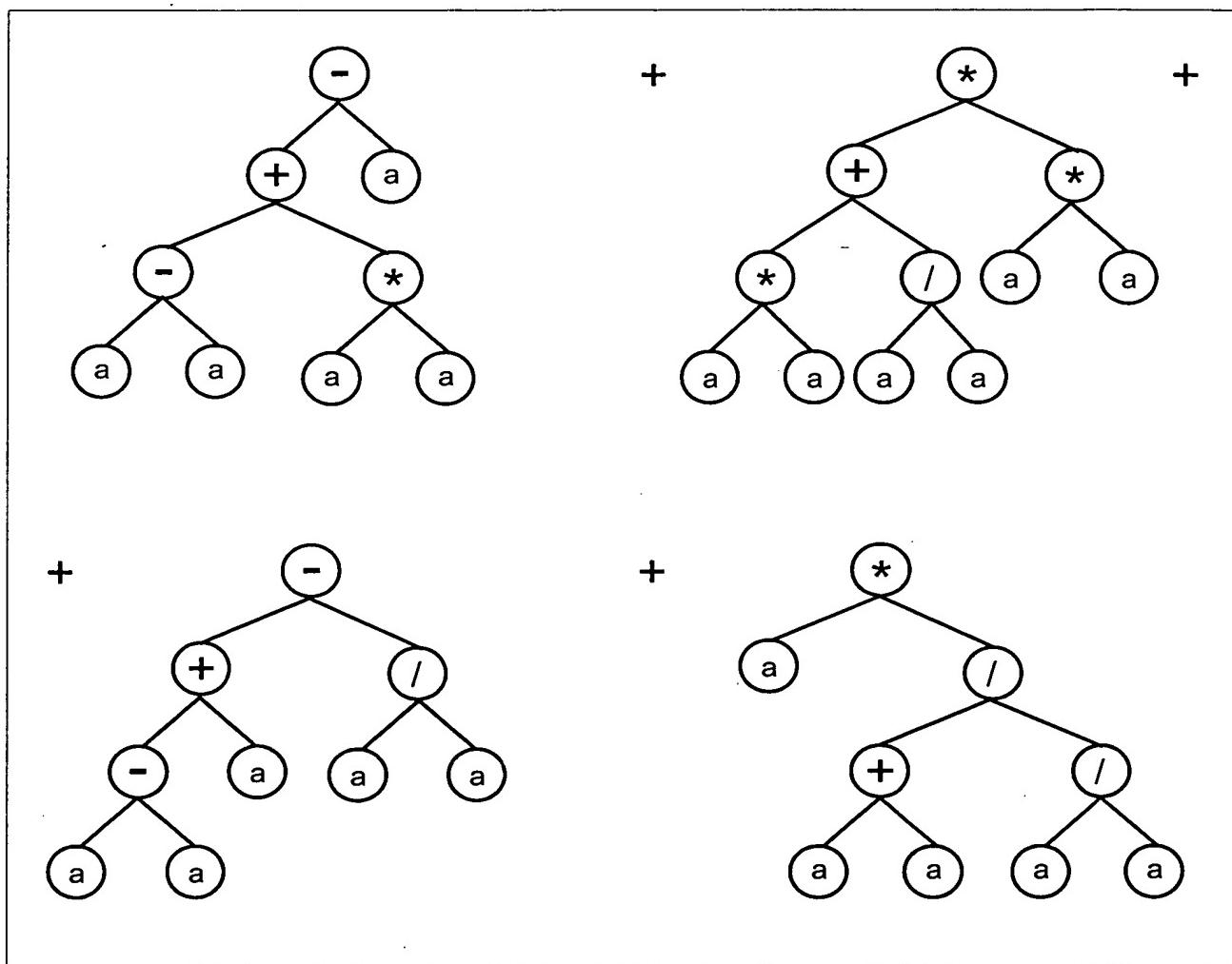
Chromosome

1201

- + a - * aaaaaaa * + ** / aaaaaaa - + / - aaaaaaaaa * a / + / aaaaaaa

Expression tree

1202



Mathematical expression

1203

$$y = (a^2 - a) + (a^4 + a^2) + (a - 1) + (2a^2) = a^4 + 4a^2 - 1$$

FIG 13

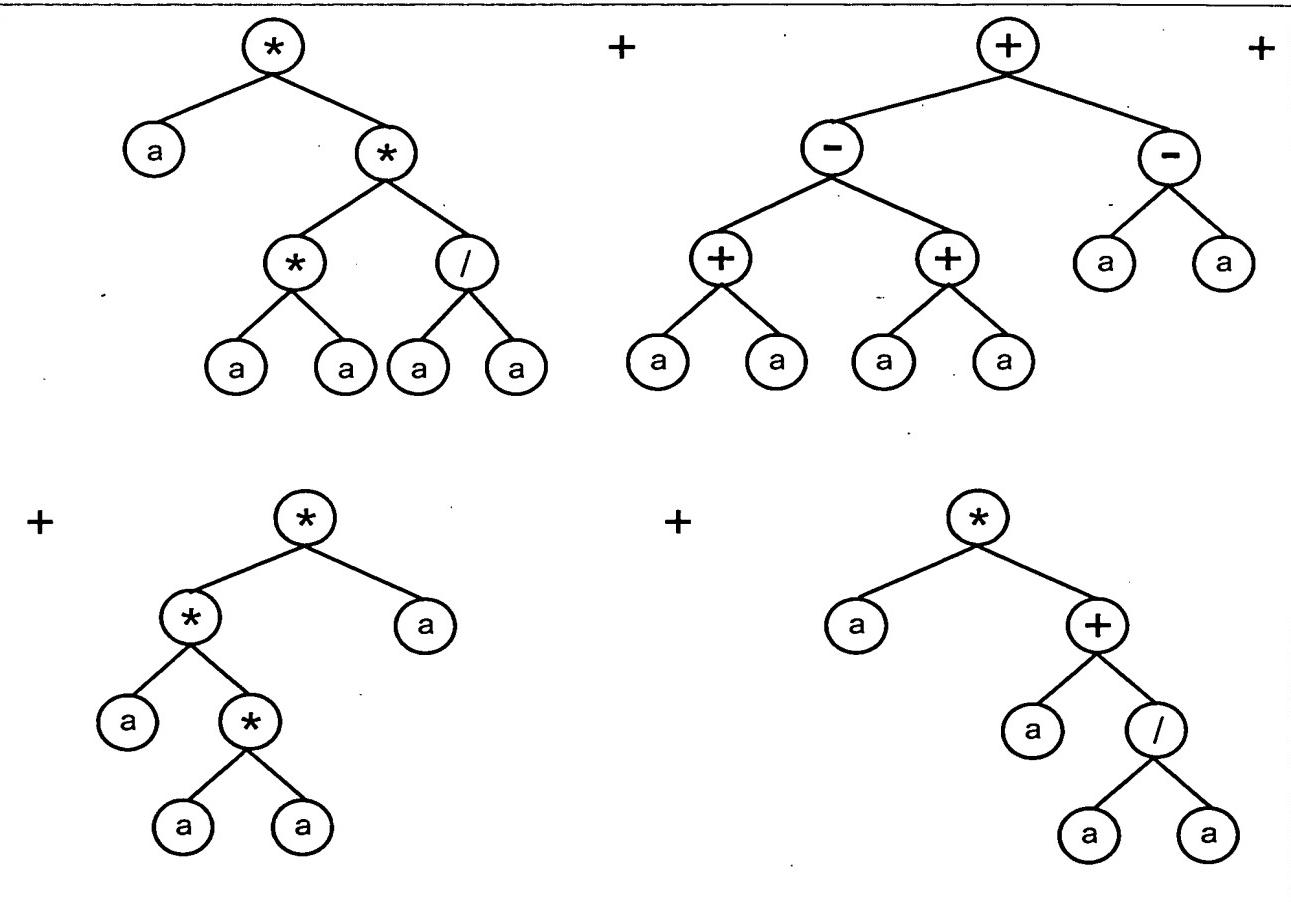
Chromosome

1301

*a**/aaaaaa+--++aaaaaa**aa*aaaaaa*a+a/aaaaaa

Expression tree

1302



Mathematical expression

1303

$$y = (a^3) + (0) + (a^4) + (a^2 + a) = a^4 + a^3 + a^2 + a$$

FIG 14

	Present Invention	Genetic Programming
G	50	51
P	30	500
C	10	20
P_s	1	0.35
R_z	1	11
F_z	15,000	5,610,000

FIG 15

Fitness cases' stacks

```
luaine###-0
unervsi##-1
auvse####-2
nalvuesri-3
s#####-4 1501
sluavn##-5
esiv#####-6
narsv###-7
vlera###-8
#####-9 1502
```

1503	Chromosomes	Fitness
	ApAAtuputCuRuputptAttCptuu-[0]	= 1
	ARRpttutpAAupupuupNCRNuttu-[1]	= 0
	CCRAptttCApNuuptppRNAAttpup-[2]	= 1
	ANpNttuptCARptutuuNRpAttut-[3]	= 1
	ARCRpptuRuuAppptpAttpuptup-[4]	= 1
	ApuApuuutAACutupuACNptppu-[5]	= 0
	RARuputppCACAppttupRRCNttutu-[6]	= 0
	AtAuppppuCuAtppptuNACAttpp-[7]	= 1
	NtNAuputpACutppptuCuCRptppu-[8]	= 0
	NtANpptutAuRptpppuRpNAutupu-[9]	= 1
	AuututtuRptRpttuRAARutupt-[10]	= 0
	CpNRTuuupCCCNpupptRptCuptuu-[11]	= 2
	RACAuptutCACTutuupNRTNptput-[12]	= 1
	AApNuuttpANCuptutuRCAutptup-[13]	= 0
	CtCututtuCAAAutptuANRNuttpt-[14]	= 0
	CAAptputtCATNutppuAtpAtutut-[15]	= 1
	NpAAuppuAAAuptpuuAttRtputt-[16]	= 1
	AARtttuuuNAARtpuuuAutuutptp-[17]	= 1
	ApRAtutptNNAAppppuACtRptuup-[18]	= 0
	AAAppppputRNACupptpACNttuptu-[19]	= 0
	CpRNppppuACANTtuttNAAAputp-[20]	= 2
	AtNAututtAupttuupARRCtuppp-[21]	= 0
	CAAAtputuAtANptpupAAptpuuut-[22]	= 1
	ARNRtuuupApAttputApRNupuut-[23]	= 0
	RtNNtputpCtAuuuppuCAANpuutu-[24]	= 0
	RCAtuupttAupAptutpAAAtttuu-[25]	= 0
	RtuAuputtAAApptutRpRpptpuu-[26]	= 1
	CpAAtputuCCpNpttutAuuRppupt-[27]	= 2
	AACRtpupuRuAAttuptCAuuppuuu-[28]	= 2
	RuAAputtuRACNuupptAuRppuupp-[29]	= 2

Chromosome number

FIG 16

Fitness cases' stacks

1601 rilasnvu#-0
 rls#####-1
 anruievls-2
 nr#####-3
 viaslre##-4
 ievlanru#-5
 uenari###-6 1602
 neai####-7
 li#####-8
 #####-9

1603 Chromosome

uNpNttuptCARpuutupNRpCtutut

Expression tree

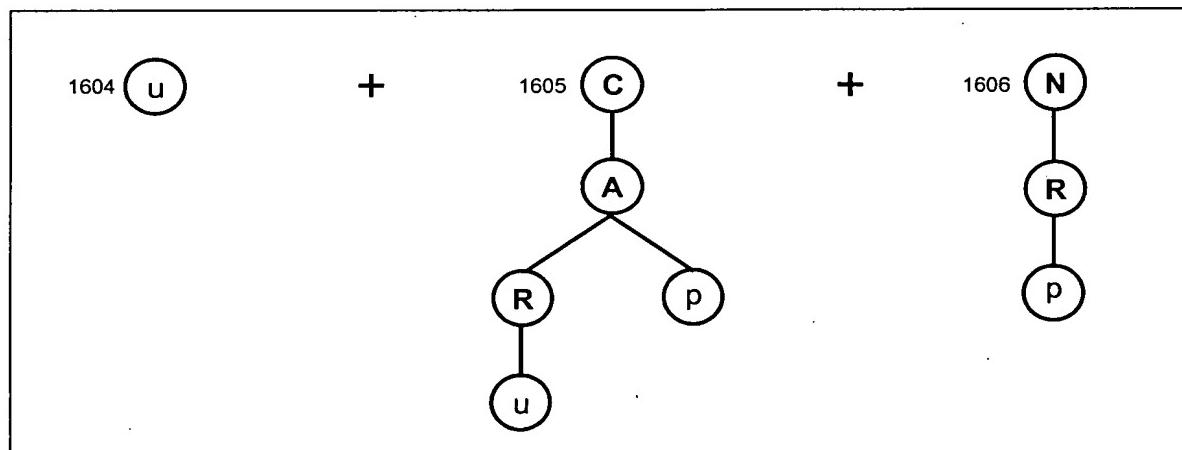


FIG 17

Fitness cases' stacks

```
s#####-0
vulnsiae-1
iuvr#####-2
riev#####-3
ui#####-4
isunrl###-5
uniav#####-6
lireav###-7
ni#####-8
#####-9
```

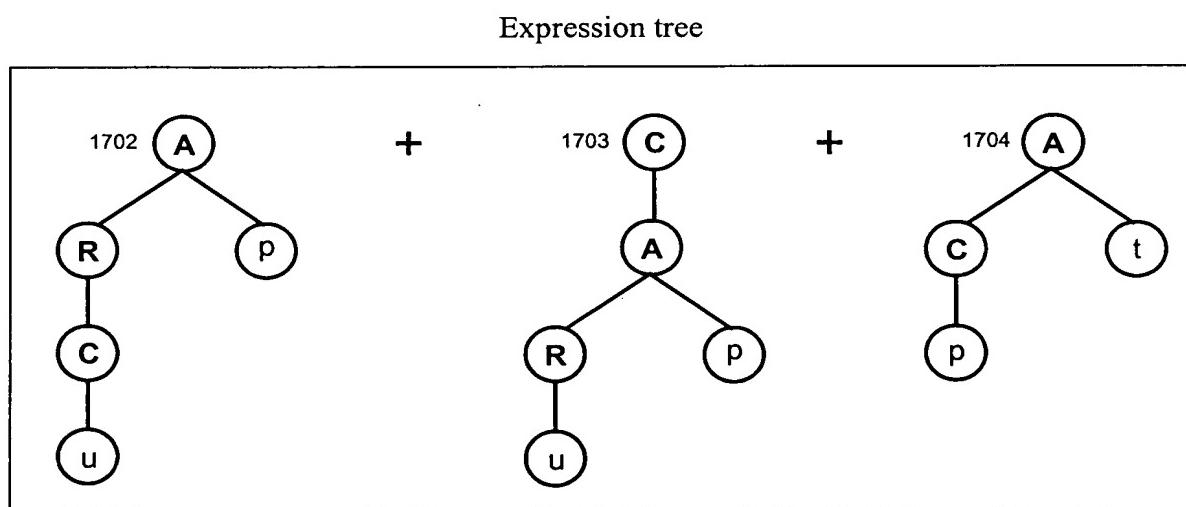
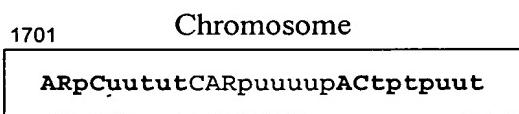


FIG 18

Fitness cases' stacks

```
avnurle##-0
vsrui####-1
uerlvsnai-2
saelnu##-3
linv#####-4
sivnrlaeu-5
vulrsaine-6
esla#####-7
vnarlsei#-8
#######--9
```

1801 Chromosome

```
CutputuptARpuuuttpACNRppuuu
```

Expression tree

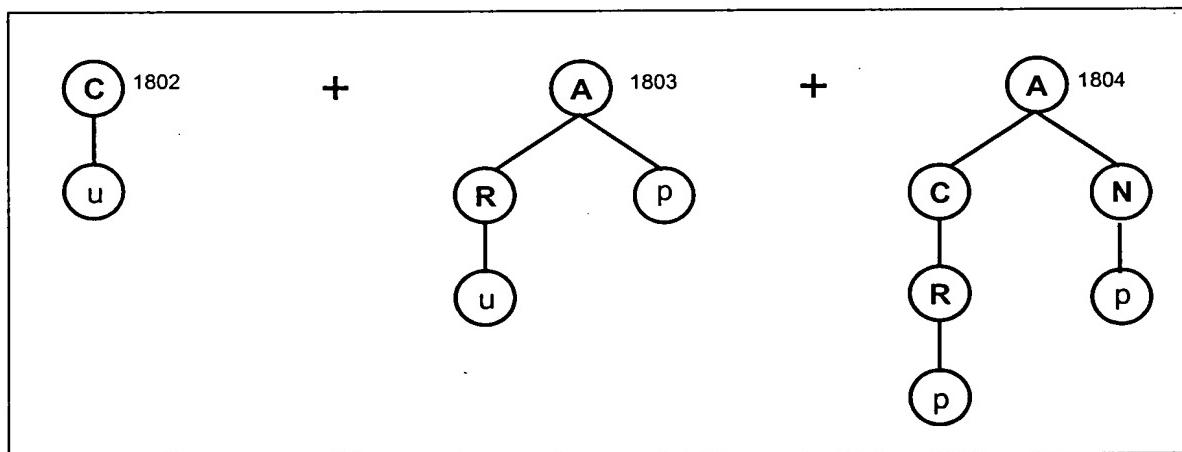


FIG 19

	Present Invention	Genetic Programming
G	100	51
P	30	500
C	10	167
P_s	0.70	0.767
R_z	4	4
F_z	120,000	17,034,000

FIG 20

2001

Chromosome

Fitness

AO31N4322a4AAAbb342444AAAaN244bb3AAA2Nb3a1b = 44

2002

Expression tree

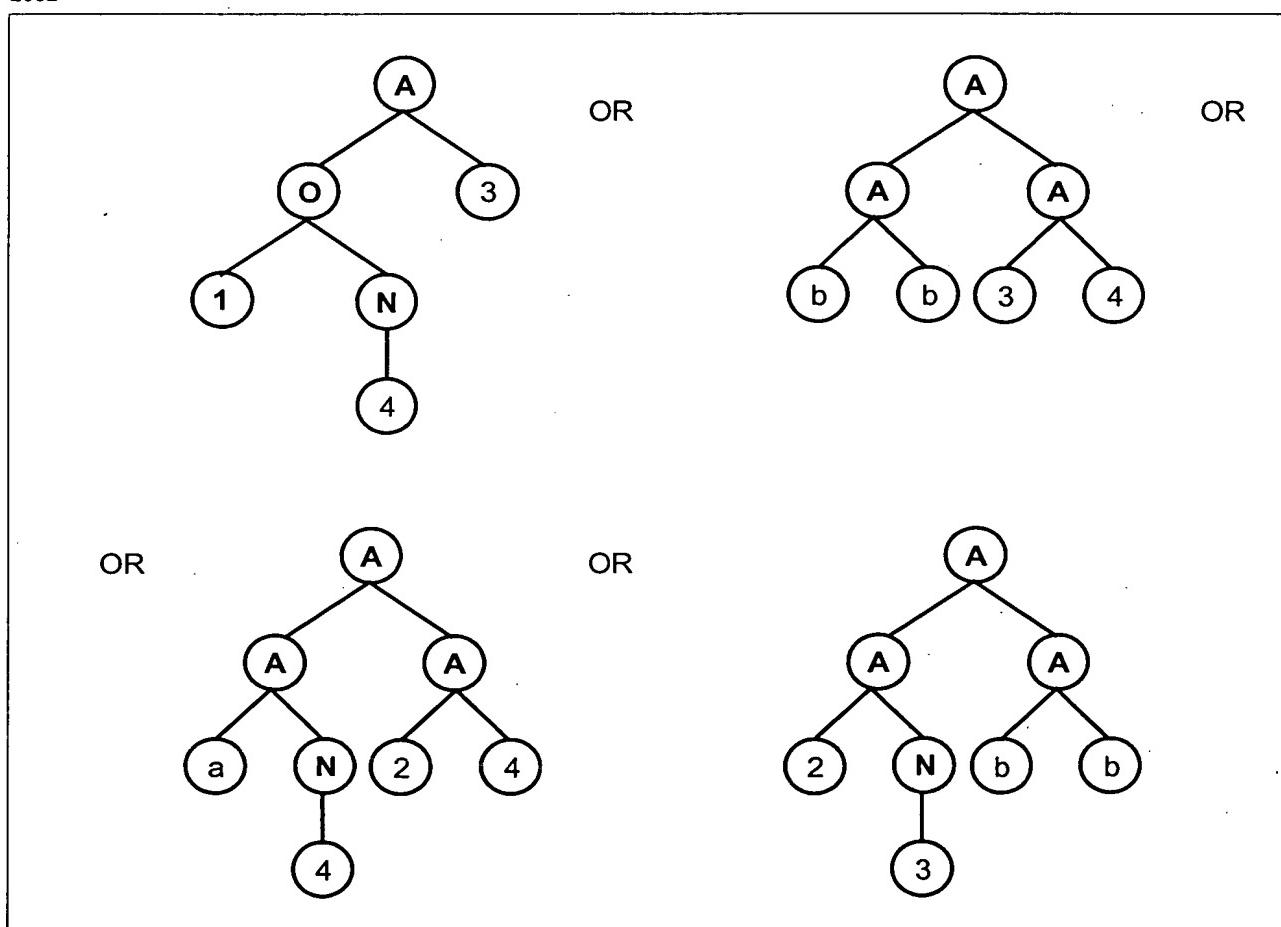


FIG 21

2101

Chromosome

Fitness

A1A2Ob4443aAaO3O133311AaO3bbb322AO21Abb4a33 = 132

2102

Expression tree

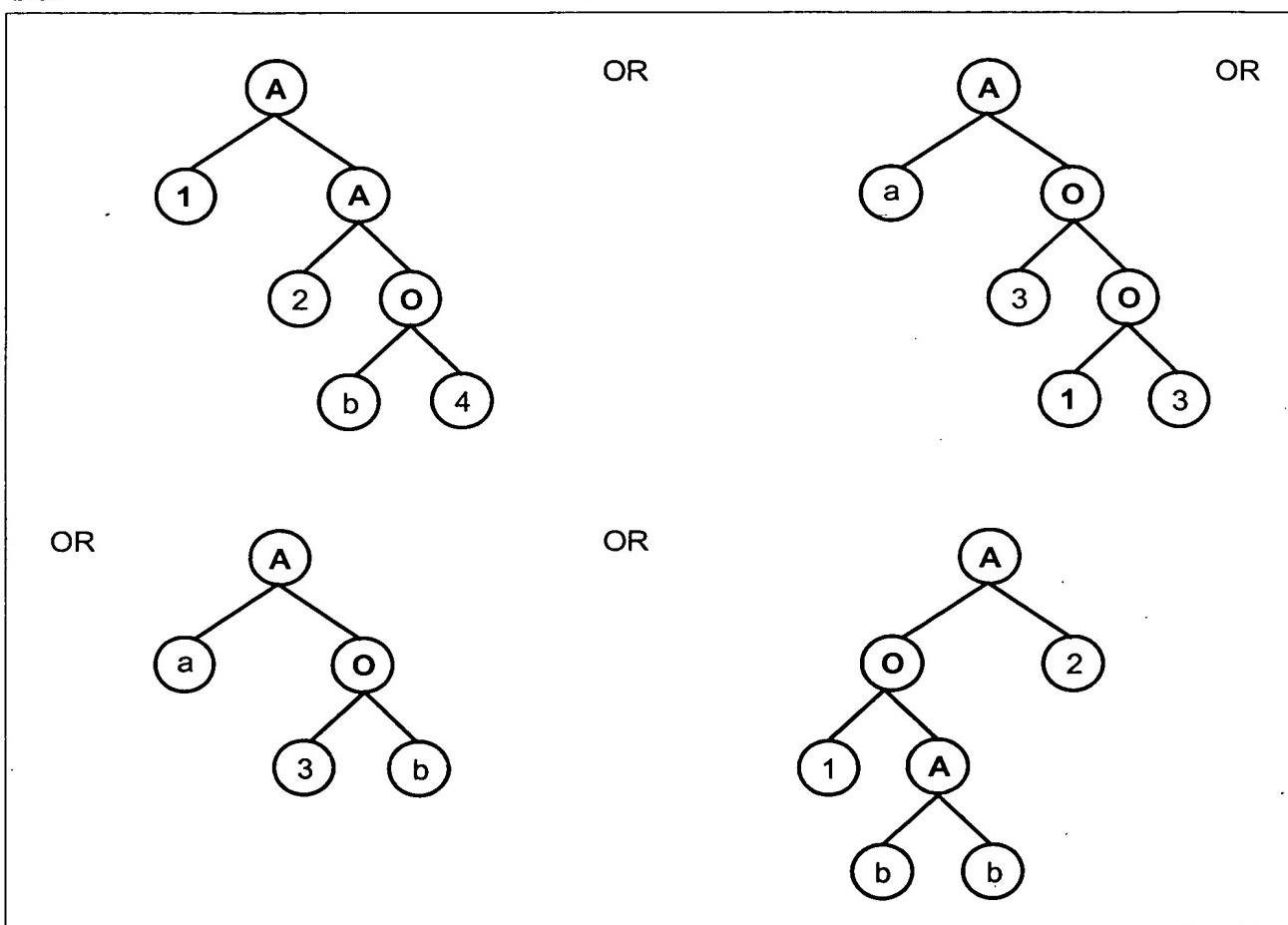


FIG 22

2201	Chromosome	Fitness
AOOOAa21b3aAaO33133311AaN31bb4321AON1Abb4a3b	=	216

2202

Expression tree

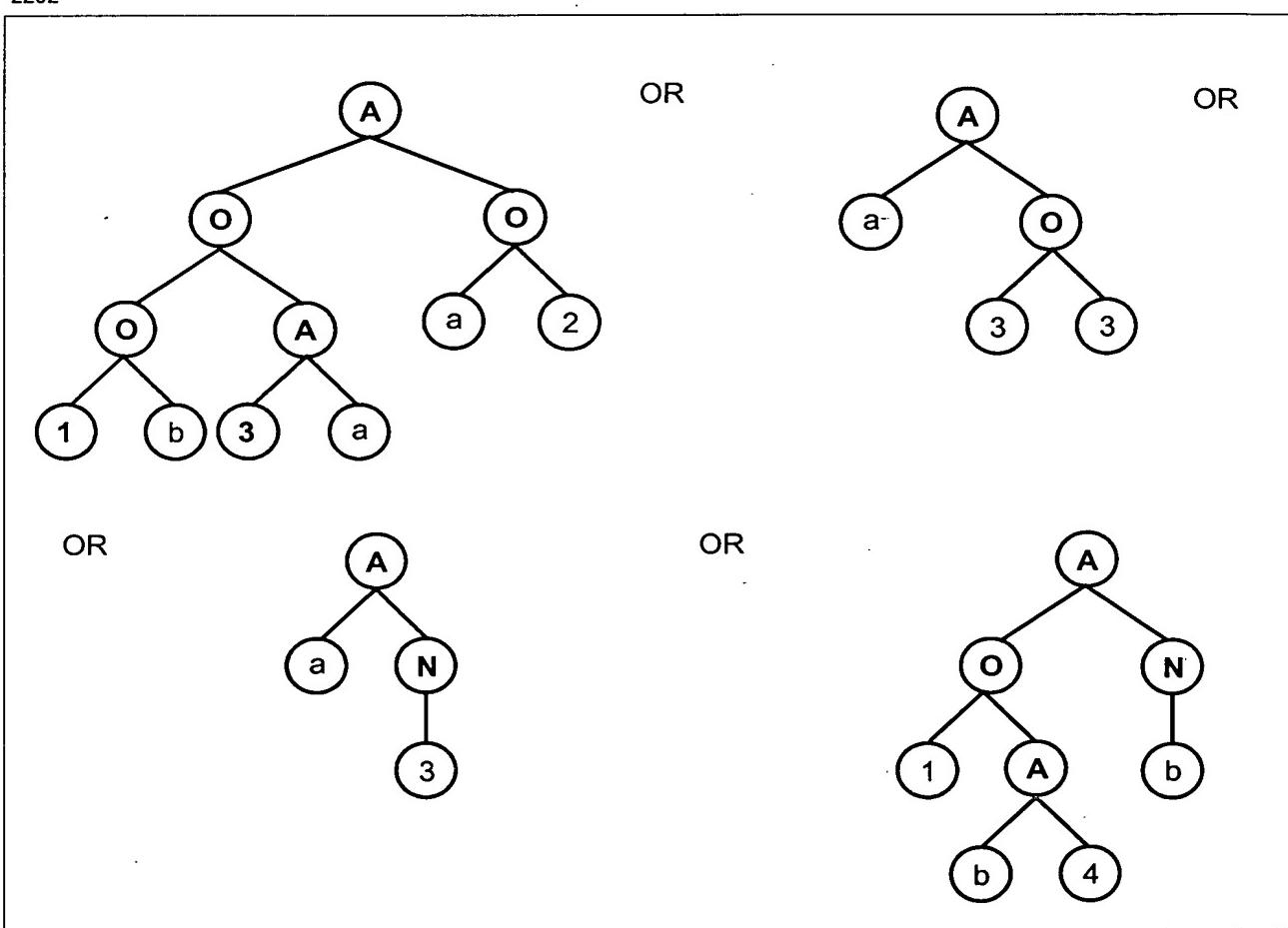


FIG 23

2301

Chromosome

Fitness

AAN2baa4b2bAAO4Ab33a31AaANA3b4312AON1bb1b233 = 310

2302

Expression tree

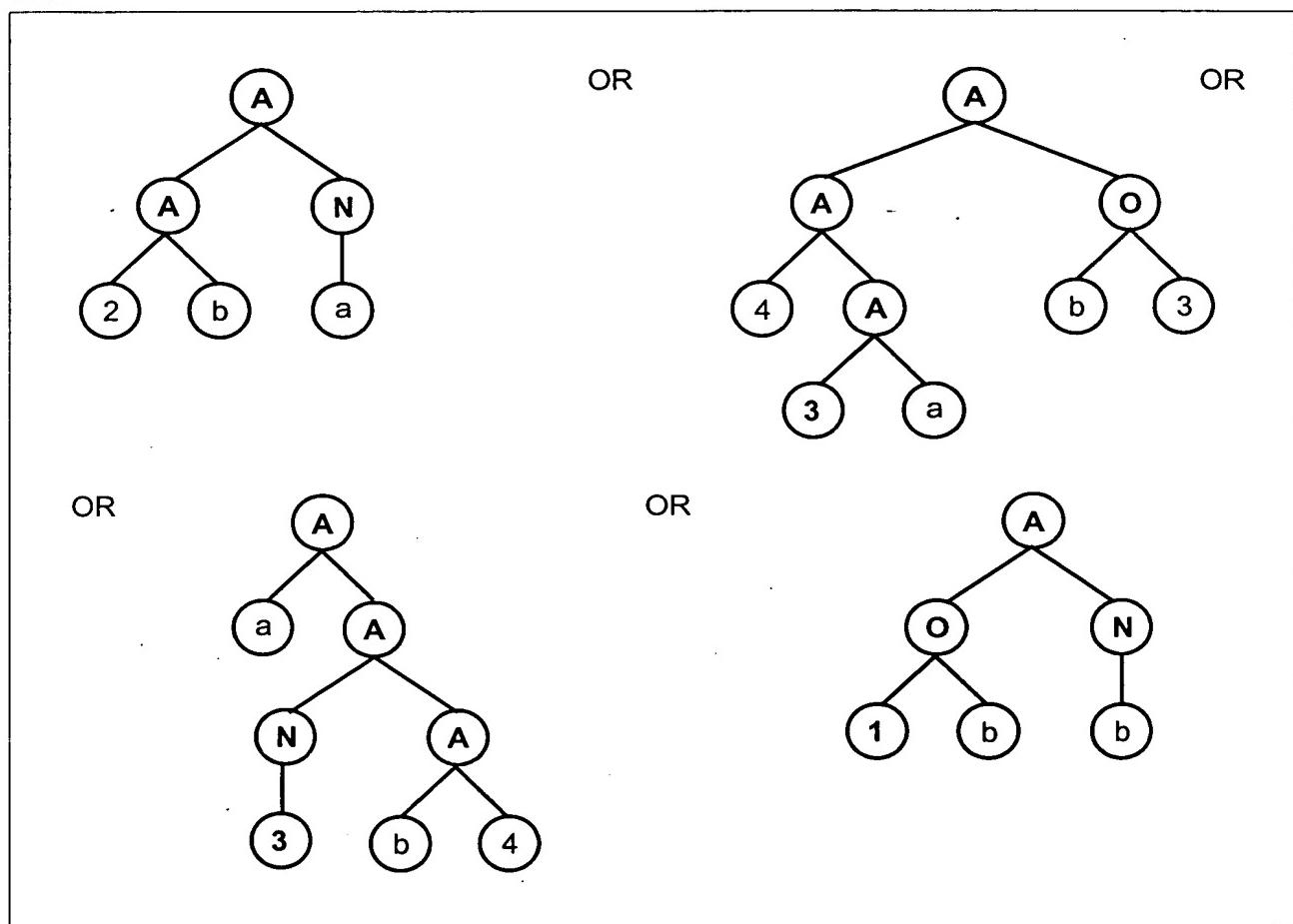


FIG 24

2401

Chromosome

Fitness

AANABA22a41AAObAb14a2bAaA3Nba1111AAN1Nba2a2b = 400

2402

Expression tree

